elongate-clavate at base, 1.5-2.5 mm long, linear above, 4-5.5 mm long. Staminate flowers *c.* 0.5 mm long; anthers broadly ovate, shortly stalked, dehiscing by apical slits. Appendix 2.2-5 cm long, cylindrical.

Fl. & Fr.: Not known.

Distribution: INDIA: Mizoram. WORLD: Indonesia (Java).

Specimen examined: MIZORAM: Lushai hills, Aijal, B. Godfrey 527 (CAL).

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51. LECTOTYPIFICATION OF *POLYSTICHUM SQUARROSUM* (D. DON) FEE VAR. *BEDDOMEI* MANICKAM & RAJKUMAR, FAMILY DRYOPTERIDACEAE

Polystichum squarrosum (D. Don) Fee is a tropical fern with morphological diversity and taxonomic complexity. Rajkumar and Manickam (*Pak. J. Biol*, 2(3): 755-758, 1999), while analysing the spore morphology of *Polystichum squarrosum* have observed two distinct types of perine and have construed them as two varieties. The specimen with winged smooth hyaline perine have been placed under var. *beddomei* and the crescent dark brown perined specimens have been placed under var. *squarrosum*. Of 20 specimens, they have found 5 specimens (XCH 241, 350, 419, 897, 922) to be var. *beddomei* and the rest (XCH 9, 291, 307, 319, 320, 415, 434, 443, 470, 561, 684, 713, 738, 824, 867) to be var. *squarrosum*. Unfortunately, var. *beddomei* has not been typified. Hence, as per the ICBN rules it is lectotyped here. The lectotype has been selected from the specimens preserved at St. Xavier's College Herbarium (XCH), Palayamkottai.

Polystichum squarrosum (D.Don) Fee var. *beddomei* Manickam & Rajkumar, Pak. J. Biol. Sci, 2(3): 755-758, Fig. 3a (1999).

Lectotype: India, Tamil Nadu, Nilgiri Hills, Thottabetta (2,650 m), 24.x.1991, Manickam, XCH 419.

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52. A COMPARATIVE STUDY ON THE REPRODUCTIVE BIOLOGY OF THREE INDIAN SPECIES OF *MARSILEA*

A comparative reproductive biological study was conducted on three Indian *Marsilea* species of the *coromandeliana* group. The species having monomorphic megaspores showed microsporal aberrations, while those with megasporal aberrations had normal microspores.

Release mechanism of the mega and microspores from their sporangia was different in these species.

Marsilea L., Family Marsileaceae, is a thoroughly investigated genus of amphibious pteridophytes. It is the most versatile fern genus morphologically and ecologically, while its reproductive biology exhibits a close correspondence to its morphological and ecological plasticity, unlike the other two genera of the family — *Regnellidium* and *Pilularia* — as well as other heterosporous aquatic ferns. The different habitats and ecological adaptations from aquatic to sub-terrestrial, terrestrial to extreme xerophyte fully concurs with a wide spectrum of reproductive mechanism (Bhardwaja 1966). Gupta (1962) and Bhardwaja (1980) have published facets of the biology of this genus.

Three Indian species of *Marsilea* L., namely *Marsilea coromandeliana* Willd., *M. kedarmalii* (Bhardwaja *et al.* 1994) and *M. shashibalii* (Bhardwaja *et al.* 2000) were selected for this study. Ripe sporocarps of the species were collected. Five sporocarps of each species were scarified and kept for germination in a petri dish containing tap water. The various stages of sexual reproduction in the three species of *Marsilea* from sorophore extrusion to sporeling formation were constantly monitored with a stereoscopic binocular microscope.

For sporal studies, ripe sporocarps of these plants were boiled in a 5% aqueous solution of potassium hydroxide (KOH) and allowed to cool to burst open the sporocarps. The sori from these ruptured sporocarps were squashed in acetocarmine. The sporangial contents were classified as per Loyal and Kumar (1979).

Spore morphology of all the three species of *Marsilea* L. shows that the megaspores are somewhat longer than broad, ellipsoidal or ovate in general outline. Megaspores of *Marsilea coromandeliana* Willd. exhibit polymorphism, which has not been found in the other two closely allied species — *M. kedarmalii* Bhardwaja *et al.* and *M. shashibalii* Bhardwaja *et al.* Megaspore polymorphism in *Marsilea coromandeliana* Willd. matches that of *Isoetes coromandeliana* L., another heterosporous pteridophyte (Gena 1980).

It was observed that while normal monomorphic megaspores are found in *M. kedarmalii* Bhardwaja *et al.* and *M. shashibalii* Bhardwaja *et al.* their microsporangia exhibit microsporangial aberrations. Along with the normal large and small microspores within the microsporangium, aberrant microspores were found in the microsporangia. [Microsporangium possesses normal microspores, monads and deformed spores.] This has also been reported earlier in *M. hirsuta* R.Br. by Feller (1953) and in *M. minuta* L. by Loyal and Kumar (1979). *M. coromandeliana* Willd. which is known to have polymorphic megaspores, showed normal monomorphic microspores. All the 64 microspores present in a microsporangium of *M. coromandeliana* Willd. were found to be of uniform size and shape.

Detailed observations regarding spore liberation, development of male and female gametes and sporeling formation have been recorded in Tables 1 and 2. Interspecific differences regarding these aspects of reproductive biology were seen.

Gupta and Bhardwaja (1956) have done considerable research on the morphology and systematics of the genus *Marsilea* L. Gupta (1962) has studied variations in size and shape of the vegetative organs and differentiation into xerophytic and hydrophytic forms in his monograph on *Marsilea* L. The occurrence of microsporangia lacking normal microspores may be attributed to the fact that increasing dryness of the habitat leads to the formation of larger number of megasporangia (Bhardwaja 1966). The available nutrition is thus utilized maximally in the formation of megaspores, and smaller

Table 1: Comparison of gametophyte and sporeling development in the three *Marsilea* species

S. No	Parameters	*Marsilea coromandeliana*	*Marsilea kedarmalii*	*Marsilea shashibalii*
1	Extrusion of sorophore (hr)	2	1	1.5
2	Length of sorophore (cm)	2.5-3	3-5	2-2.5
3	No. of sori / sporocarp	8-12	10-15	7-11
4	No. of microspores/microsporangium	64	64 (16-24 normal spores)	64 (12-24 normal spores)
5	No. megaspores/sporocarp (Average)	70	91	54
6	Release of megaspores (hr)	8-10	2-3	6-8
7	Sporal morphology			
	a) Microspores	Normal	Aberrant	Absent
	b) Megaspores	Aberrant	Normal	Normal
8	Release of microspores (hr)	10-12	3-4	6-8
9	Bursting of microspores (hr)	12-14	6-10	9-12
10	Female gametophyte development (hr) (Formation of green apical mound)	12-14	10-12	12-14
11	Spore germination %			
	a) Microspores	60	70	65
	b) Megaspores	42.4	46.5	32.4
12	Dark germination %			
	a) Microspores	Absent	40	25
	b) Megaspores	Absent	20	Absent
13	Rhizoids on developing female gametophyte	Absent	Present	Present
14	Development of archegonium (hr)	18-20	16-18	18-20
15	Liberation of antherozoids (hr)	20-22	18-20	20-22
16	Sporeling initiation (hr)	38-40	26-32	34-38
17	First leaf initiation (hr)	64-70	48-52	54-58
18	First root initiation (hr)	72-80	58-68	72-78
19	Development of sporophyte from isolated megaspore	Nil	14.2 %	Nil

Table 2: Sporocarp contents of three *Marsilea* species

Sl. No.	Parameters	*Marsilea coromandeliana*	*Marsilea kedarmalii*	*Marsilea shashibalii*
1	Number of Sori/ sporocarp			
	Range	8-12	10-15	7-11
	Average	10	13	9
2	Number of Megaspores/ sorus			
	Range	5-7	4-9	4-9
	Average	7	7	6
3	Number of Microsporangia/ sorus			
	Range	5-14	5-10	4-7
	Average	10	8	6
4	Number of Microspores/ Microsporangium	64 (no aberrant spores)	64 (16-24 normal spores)	64 (12-24 normal spores)

numbers of normal microspores, and aberrant spores of various types are thus more frequent. Both increasing dryness and temperature are responsible for spore variation in *Marsilea* L. (Shattuck 1910).

Aspects of heterospory, specially microsporal aberrations, so frequent in some species of *Marsilea* L., have been studied in detail by Bhardwaja and Wadhwani (1984), and Bhardwaja (1986). Sen (1989), Soni (1989) and Wadhwani (1989) have discussed apogamy and parthenogenetic development of sporelings in *Marsilea* L. and have correlated microsporal aberrations with apogamous and parthenogenetic sporeling formation.

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